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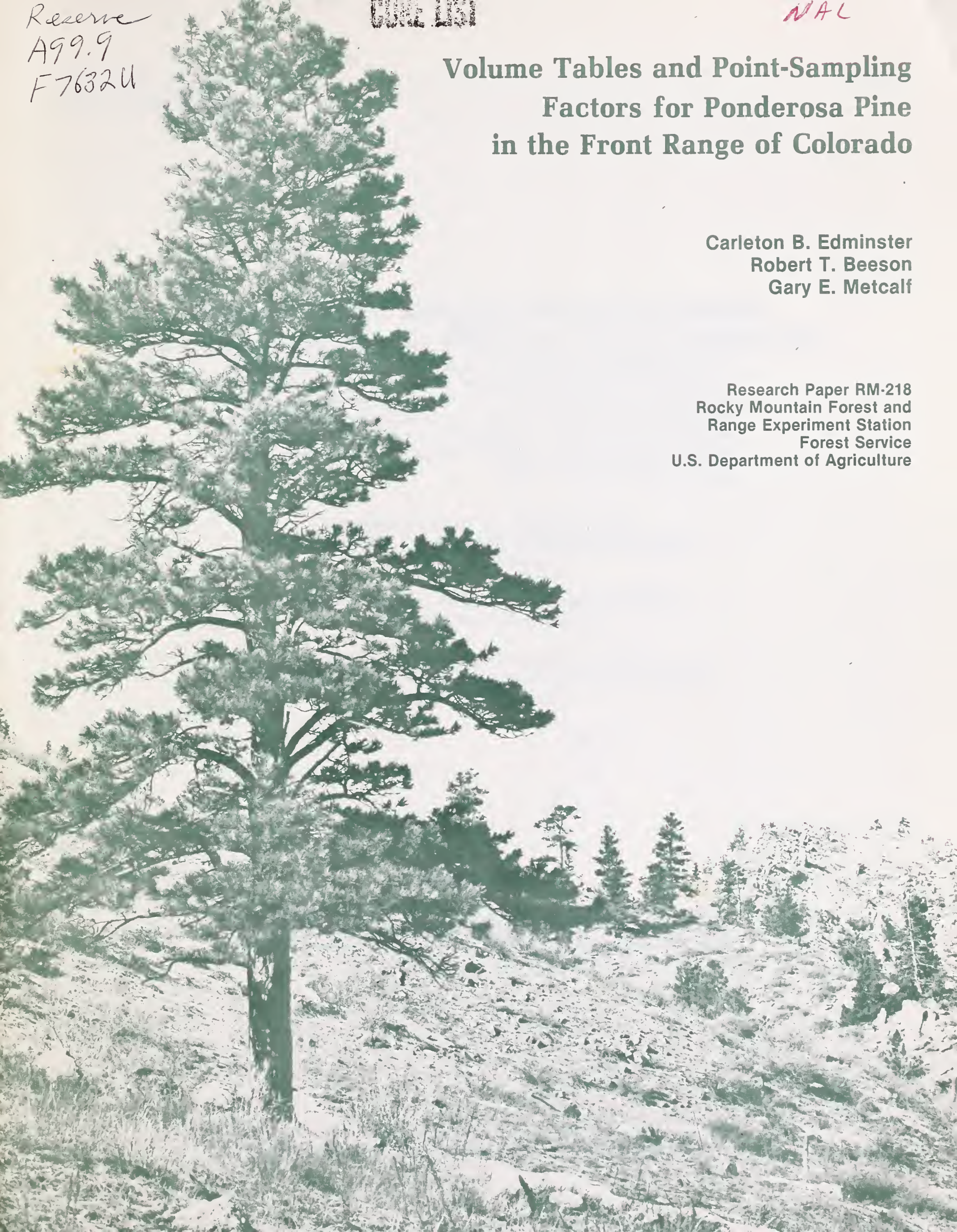# Volume Tables and Point-Sampling Factors for Ponderosa Pine in the Front Range of Colorado

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Abstract

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Volume tables are presented for total cubic feet, merchantable cubic feet to a 4-inch top, board feet Scribner Rule to a 6-inch top, and board feet International 1/4-inch Rule to a 6-inch top. Point-sampling factor tables are given for merchantable volumes per square foot of basal area. Tree heights are expressed as total height in feet and merchantable height in numbers of logs. Volume equations are the form $V = a + bD^2H$.

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Volume Tables and Point-Sampling Factors for Ponderosa Pine in the Front Range of Colorado.

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Contents

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Volume Tables and Point-Sampling Factors for Ponderosa Pine in the Front Range of Colorado

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Management Highlights

Eleven tables presented here give values and equations needed to determine the volumes of ponderosa pine (*Pinus ponderosa* var. *scopulorum* Engelm.) trees in the Front Range of the Rocky Mountains in Colorado. The tables provide:

1. Gross volumes, in cubic feet, of the entire stem.
2. Gross merchantable volumes, in cubic feet, to a 4-inch top.
3. Gross merchantable volumes, in board feet, Scribner and International 1/4-inch Rules, to a 6-inch top.

4. Point-sampling factors giving merchantable volumes in cubic feet and board feet per square foot of basal area.

Stand volumes on an area may be determined from: (1) measurements of all tree diameters and heights, (2) measurements of all tree diameters and sufficient heights to convert the appropriate volume tables to local volume tables (Chapman and Meyer 1949), or (3) tree tallies obtained by point sampling.

Definitions and Standards

Diameter at breast height (d.b.h.).—Measured to the nearest 0.1 inch, outside the bark, at 4.5 feet above ground level, on the uphill side of the tree. Full-inch-diameter classes, with class midpoints at the 1/2-inch marks, are used in the tables.

Total height.—Measured, in whole feet to the nearest foot, from ground level on the uphill side of the tree upward to the tip. Trees forked below utilization limits described below, stag-topped, or severely deformed were not included in the sample. The midpoints of total height classes in the tables are multiples of 10 feet.

Scaling diameter of logs.—Average diameter inside bark to nearest 0.1 inch, measured at the small end of logs or half-logs.

Minimum top diameters for merchantable volumes.—Minimum top diameter inside bark for computation of merchantable cubic-foot volume was 4 inches. For board-foot volume, a minimum top diameter inside bark of 6 inches was used to conform to local practice. Logs with a scaling diameter smaller than 5.6 inches usually were not included in saw-log volume. A few logs with smaller scaling diameters were included to satisfy the "4-foot rule" described below.

Merchantable length in logs.—Measured from 1 foot above ground level on the uphill side of the tree, upward to the limit of saw-log utilization. Each tree was sectioned into as many 16.5-foot-long logs as possible. An additional half-log, if available, was taken from the uppermost part of the merchantable length. Portions of the bole above the height of minimum top diameter inside bark were included in the uppermost saw-log if the standard log or half-log length ended within 4 feet above this height. This "4-foot rule" was used to avoid a negative bias in volume determination (Chapman and Meyer 1949).

Explanation of Tables

General definitions and standards given above apply to all tables listed in the appendix. Explanation of each type of table and suggestions for use follow.

Volume Tables

Headings and footnotes of each volume table (table 1 and even-numbered tables) give units of volume and height measurement, utilization standards, and volume equations used in compilation. Full-inch-diameter classes and 10-foot-height classes or half-log-length classes were used in all tables.

The volume tables were developed from linear regressions of V and D²H or D²L of the form:

$$V = a + bD^2H \text{ or } V = a + bD^2L$$

where:

V = gross volume inside bark in the appropriate unit
D = d.b.h. outside bark in inches
H = total height in feet
L = merchantable length in standard logs and half-logs
a, b = regression coefficients

Graphs of V versus D²H or D²L for all volume relationships did not indicate a nonlinear expression was needed to cover the full range of the basic data. Unfortunately, the linear regression equations for board-foot volumes gave negative estimates for small values of D²H or D²L. To correct this, the volume of a half-log with minimum top diameter has been substituted as described in the footnotes for tables 4, 6, 8, and 10.

The number of logs in a tree shown in tables 6 and 10 is not necessarily the number that will actually be cut from it. It is the number of logs between the 1-foot above ground level and the height of minimum top diameter. Volume of nonmerchantable logs below the height of minimum top diameter should be deducted from tree volume by: (1) estimation of scaling diameters and deduction of appropriate log volumes, or (2) use of taper tables to determine scaling diameters and deduction of log volumes. Volume should not be reduced by tallying fewer logs in the tree.

Point-Samping Factors

Odd-numbered tables from tables 3 through 11 give point-sampling factors for combinations of tree d.b.h. and height or merchantable length. Tabulated volumes per square foot of basal area were obtained from equations given in the table footnotes. These equations were derived by dividing each term of the corresponding tree volume equation by tree basal area in square feet ($B = 0.0054542 D^2$).

Point-sample cruising to estimate stand volume can be done in several ways: (1) measure the d.b.h. and height of each tree tallied through the prism, angle gage, or relascope; (2) measure the height of each tallied tree and estimate its d.b.h.; or (3) measure the heights of the tallied trees and make no record of d.b.h.'s. The procedure selected will depend on the precision desired. Relative precision is usually in the order listed above. If the d.b.h. and height of each tallied tree are measured, a volume conversion factor can be selected from the tables or computed from the appropriate equations for each combination of d.b.h. and height. Volume per acre is then computed as follows:

1. Multiply the number of tallied trees in each d.b.h.-height class by the point-sampling factor for the class.
2. Total the products of step 1.
3. Multiply the total of step 2 by the basal area factor of the angle gage used.
4. Divide the product of step 3 by the number of points sampled on the tract.

Considerable time often can be saved if the heights of tallied trees are measured, while d.b.h.'s are estimated and recorded by broad classes. Inspection of the point-sampling factor tables shows that volumes per square foot of basal area, for trees larger than 15 inches d.b.h., often do not differ greatly among trees of a single height class. The increased time spent measuring d.b.h.'s may not increase precision materially. When the distribution of d.b.h.'s and heights inventoried indicates there is little change in volume per square foot within a height class, it is recommended that d.b.h.'s not be recorded at all. Point-sampling factors for each height class can be computed using a procedure similar to deriving a local volume table from a standard table (Chapman and Meyer 1949).

The techniques of point sampling have been described in numerous publications (Dilworth and Bell 1971; Grosenbaugh 1952, 1955, 1958). Procedures for computing tree volumes and point-sampling factors using programmable calculators have been developed by Shepperd (1980).

Metric Equations for Cubic Volume

The following equations are the metric equivalents (Myers and Edminster 1974) of the cubic-foot volume equations used to develop tables 1-3.

Gross volume of the entire stem in cubic meters:

$$V_m = 0.0000325 \, D_m^2 H_m$$

Gross merchantable volume in cubic meters to a 10-cm top:

$$V_m = 0.0000311 \, D_m^2 H_m - 0.01265$$

Gross merchantable volume in cubic meters per square meter of basal area:

$$V_m/B_m = 0.39618 \, H_m - 161.14650/D_m^2$$

where:

V_m = gross volume inside bark in cubic meters
D_m = d.b.h. outside bark in centimeters
H_m = total height in meters
B_m = tree basal area in square meters

Literature Cited

Chapman, Herman H., and Walter H. Meyer. 1949. Forest mensuration. 522 p. McGraw-Hill Book Co., Inc. New York, N.Y.

Dilworth, J. R., and J. F. Bell. 1971. Variable probability sampling-variable plot and three-P. 130 p. Oregon State University Book Stores, Inc., Corvallis.

Grosenbaugh, L. R. 1952. Plotless timber estimates—New, fast, easy. Journal of Forestry 50:32-37.

Grosenbaugh, L. R. 1955. Better diagnosis and prescription in southern forest management. U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Occasional Paper 145, 27 p.

Grosenbaugh, L. R. 1958. Point-sampling and line-sampling: Probability theory, geometric implications, synthesis. USDA Forest Service, Southern Forest Experiment Station, Occasional Paper 160, 34 p.

Myers, Clifford A., and Carleton B. Edminster. 1974. Conversion of tree-volume equations to the metric system. USDA Forest Service Research Note RM-261, 2 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

Shepperd, Wayne D. 1980. Hand-held-calculator programs for the field forester. USDA Forest Service General Technical Report RM-76. 17 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

Table 1.—Gross volumes, in cubic feet inside bark, of entire stem including stump and top, ponderosa pine in the Front Range of Colorado

d.b.h.	Total height (feet) above ground										Basis: trees
	10	20	30	40	50	60	70	80	90	100	
inches											
1	0.1	0.1									18
2	0.1	0.3	0.4	0.6							21
3	0.3	0.6	0.8	1.1							29
4	0.5	0.9	1.4	1.8							36
5	0.7	1.4	2.1	2.7	3.4						41
6		1.9	2.9	3.8	4.8						36
7		2.5	3.8	5.1	6.4	7.6					40
8		3.3	4.9	6.5	8.2	9.8	11.4				64
9		4.1	6.1	8.2	10.2	12.2	14.3				59
10		5.0	7.5	10.0	12.5	14.9	17.4				77
11		6.0	9.0	12.0	14.9	17.9	20.9	23.9			55
12		7.1	10.6	14.1	17.7	21.2	24.7	28.3			80
13		8.2	12.4	16.5	20.6	24.7	28.8	33.0			83
14			14.3	19.0	23.8	28.5	33.3	38.0			68
15			16.3	21.7	27.1	32.6	38.0	43.4			58
16			18.5	24.6	30.8	36.9	43.1	49.2	55.4		52
17			20.8	27.7	34.6	41.5	48.4	55.4	62.3		58
18			23.2	30.9	38.7	46.4	54.1	61.9	69.6		35
19			25.8	34.4	43.0	51.6	60.2	68.7	77.3		18
20			28.5	38.0	47.5	57.0	66.5	76.0	85.5		18
21				41.8	52.2	62.7	73.1	83.6	94.0		19
22				45.8	57.2	68.6	80.1	91.5	103.0	114.4	20
23				49.9	62.4	74.9	87.4	99.8	112.3	124.8	8
24					67.8	81.4	95.0	108.5	122.1	135.7	4
25					73.5	88.2	102.9	117.6	132.3	147.0	5
26					79.4	95.2	111.1	127.0	142.8	158.7	3
27					85.5	102.5	119.6	136.7	153.8	170.9	2
28						110.1	128.5	146.9	165.2	183.6	0
29						118.0	137.7	157.3	177.0	196.7	1
30						126.1	147.2	168.2	189.2	210.2	0
Basis: trees	30	60	157	269	278	166	38	9	1	0	1,008

Block indicates extent of data.
Computed from: $V = 0.00226\ D^2H$
Standard error of estimate: ±14.16% of mean; ±2.9 cubic feet
Coefficient of determination: 0.9787
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 2.—Gross merchantable volumes, in cubic feet inside bark, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 4 inches inside bark. Stump height 1 foot

d.b.h.	Total height (feet) above ground									Basis: trees
	20	30	40	50	60	70	80	90	100	
inches										
5	0.9	1.5	2.2	2.8						41
6	1.4	2.3	3.2	4.1						36
7	2.0	3.2	4.4	5.6	6.8					40
8	2.7	4.2	5.8	7.4	8.9	10.5				64
9	3.5	5.4	7.4	9.3	11.2	13.2				59
10	4.3	6.7	9.1	11.5	13.8	16.2				77
11	5.3	8.1	11.0	13.8	16.7	19.5	22.4			55
12	6.3	9.7	13.1	16.4	19.8	23.2	26.6			80
13	7.4	11.4	15.3	19.2	23.2	27.1	31.0			83
14		13.2	17.7	22.3	26.8	31.3	35.9			68
15		15.1	20.3	25.5	30.7	35.9	41.1			58
16		17.2	23.1	29.0	34.8	40.7	46.6	52.5		52
17		19.4	26.0	32.6	39.2	45.9	52.5	59.1		58
18		21.7	29.1	36.5	43.9	51.3	58.7	66.1		35
19		24.2	32.4	40.6	48.8	57.0	65.3	73.5		18
20		26.8	35.9	44.9	54.0	63.1	72.2	81.2		18
21			39.5	49.5	59.5	69.4	79.4	89.4		19
22			43.3	54.2	65.2	76.1	87.0	98.0	108.9	20
23			47.3	59.2	71.1	83.1	95.0	106.9	118.8	8
24				64.4	77.3	90.3	103.3	116.2	129.2	4
25				69.8	83.8	97.9	111.9	126.0	140.0	5
26				75.4	90.6	105.7	120.9	136.1	151.2	3
27				81.2	97.6	113.9	130.2	146.6	162.9	2
28					104.8	122.4	139.9	157.5	175.0	0
29					112.3	131.1	149.9	168.7	187.5	1
30					120.1	140.2	160.3	180.4	200.5	0
Basis: trees	11	132	269	278	166	38	9	1	0	904

Block indicates extent of data.
Computed from: $V = 0.00216\ D^2H - 0.44670$
Standard error of estimate: ± 14.29% of mean; ± 3.0 cubic feet
Coefficient of determination: 0.9744
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 3.—Gross merchantable volumes, in cubic feet inside bark per square foot of basal area, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 4 inches inside bark. Stump height 1 foot

d.b.h.	Total height (feet) above ground								
	20	30	40	50	60	70	80	90	100
inches									
5	5.2	9.2	13.1	17.1					
6	6.0	9.9	13.9	17.9					
7	6.5	10.4	14.4	18.3	22.3				
8	6.8	10.7	14.7	18.7	22.6	26.6			
9	7.0	11.0	14.9	18.9	22.9	26.8			
10	7.2	11.1	15.1	19.1	23.0	27.0			
11	7.3	11.3	15.2	19.2	23.1	27.1	31.1		
12	7.4	11.4	15.3	19.3	23.2	27.2	31.2		
13	7.5	11.4	15.4	19.4	23.3	27.3	31.2		
14		11.5	15.5	19.4	23.4	27.3	31.3		
15		11.5	15.5	19.5	23.4	27.4	·31.3		
16		11.6	15.5	19.5	23.5	27.4	31.4	35.3	
17		11.6	15.6	19.5	23.5	27.5	31.4	35.4	
18		11.6	15.6	19.6	23.5	27.5	31.4	35.4	
19		11.7	15.6	19.6	23.5	27.5	31.5	35.4	
20		11.7	15.6	19.6	23.6	27.5	31.5	35.4	
21			15.7	19.6	23.6	27.5	31.5	35.5	
22			15.7	19.6	23.6	27.6	31.5	35.5	39.4
23			15.7	19.7	23.6	27.6	31.5	35.5	39.5
24				19.7	23.6	27.6	31.5	35.5	39.5
25				19.7	23.6	27.6	31.6	35.5	39.5
26				19.7	23.6	27.6	31.6	35.5	39.5
27				19.7	23.7	27.6	31.6	35.5	39.5
28					23.7	27.6	31.6	35.5	39.5
29					23.7	27.6	31.6	35.5	39.5
30					23.7	27.6	31.6	35.6	39.5

Computed from: $V/B = 0.39603H - 81.90019/D^2$
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 4.—Gross volumes, in board feet inside bark Scribner Rule, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 6 inches inside bark. Stump height 1 foot

d.b.h.	Total height (feet) above ground								Basis: trees
	30	40	50	60	70	80	90	100	
inches									
7	8	8	8	14					26
8	8	9	17	25	34				63
9	8	17	27	38	48				58
10	13	26	39	51	64				77
11	21	36	51	67	82	97			55
12	29	47	65	83	101	119			77
13	38	59	80	101	122	143			83
14	48	72	96	120	145	169			68
15	58	86	113	141	169	196			58
16	69	101	132	163	194	226	257		51
17	81	116	151	187	222	257	292		58
18	93	133	172	211	251	290	329		35
19	107	150	194	238	281	325	369		18
20	120	169	217	265	313	362	410		18
21		188	241	294	347	400	453		19
22		208	266	324	383	441	499	557	20
23		229	293	356	420	483	547	610	8
24			320	389	458	527	596	665	4
25			349	424	498	573	648	723	5
26			379	460	540	621	702	782	3
27			410	497	584	671	757	844	2
28				535	629	722	815	909	0
29				575	675	775	875	975	1
30				617	724	831	937	1,044	0
Basis: trees	70	247	276	166	38	9	1	0	807

Block indicates extent of data
Computed from: V = 8 for D²H to 2,830; V = 0.01149 D²H − 24.5404 for D²H larger than 2,830
Standard error of estimate: ± 25.36% of mean; ± 26 board feet
Coefficient of determination: 0.9351
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

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Table 5.—Gross volumes, in board feet inside bark Scribner Rule per square foot of basal area, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 6 inches inside bark. Stump height 1 foot

d.b.h.	Total height (feet) above ground							
	30	40	50	60	70	80	90	100
inches								
7	26	26	26	46				
8	20	22	43	64	85			
9	16	34	55	77	98			
10	22	43	65	86	107			
11	29	50	71	92	113	135		
12	34	55	77	98	119	140		
13	39	60	81	102	123	144		
14	42	63	84	105	126	147		
15	44	66	87	108	129	150		
16	47	68	89	110	131	152	173	
17	49	70	91	112	133	154	175	
18	50	71	92	113	134	155	176	
19	51	72	93	115	136	157	178	
20	52	74	95	116	137	158	179	
21		75	96	117	138	159	180	
22		75	96	118	139	160	181	202
23		76	97	118	139	160	181	203
24			98	119	140	161	182	203
25			98	119	141	162	183	204
26			99	120	141	162	183	204
27			99	120	142	163	184	205
28				121	142	163	184	205
29				121	142	163	184	205
30				122	143	164	185	206

Computed from: V/B = 1,466.75956/D² for D²H to 2,830; V/B = 2.10663H − 4,499.35829/D² for D²H larger than 2,830

Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 6.—Gross volumes, in board feet inside Scribner Rule, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 6 inches inside bark. Stump height 1 foot

d.b.h.	Number of 16-foot logs to 6-inch top										Basis: trees
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
inches											
7	8	8	13	19							26
8	8	10	18	26	35						63
9	8	14	24	34	45						58
10	8	19	31	44	56						77
11	9	24	39	53	68	83					55
12	11	29	47	64	82	100	117				77
13	14	35	55	76	97	117	138	158			83
14		41	65	89	112	136	160	183			68
15		48	75	102	129	156	183	211			58
16		55	86	117	147	178	209	239	270		51
17		63	97	132	166	201	236	270	305		58
18		71	110	148	187	225	264	303	341		35
19		80	122	165	208	251	294	337	380		18
20		89	136	183	231	278	326	373	420		18
21			150	202	254	307	359	411	463		19
22			165	222	279	336	393	451	508	565	20
23			181	243	305	367	430	492	554	617	8
24				265	332	400	468	535	603	671	4
25					360	434	507	580	654	727	5
26					390	469	548	627	707	786	3
27					420	506	591	676	761	847	2
28					452	543	635	727	818	910	0
29					485	583	681	779	877	975	1
30						623	728	833	938	1,043	0
Basis: trees	44	104	187	212	150	87	18	4	1	0	807

Block indicates extent of data.
Computed from: $V = 8$ for D^2L to 63; $V = 0.22556 D^2L - 6.22508$ for D^2L larger than 63
Standard error of estimate: $\pm 23.15\%$ of mean; ± 24 board feet
Coefficient of determination: 0.9459
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 7.—Gross volumes, in board feet inside bark Scribner Rule per square foot of basal area, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 6 inches inside bark. Stump height 1 foot

d.b.h.	Number of 16-foot logs to 6-inch top									
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
inches										
7	26	26	42	62						
8	20	26	46	67	88					
9	16	29	49	70	91					
10	13	31	52	72	93					
11	12	33	53	74	95	115				
12	13	34	55	75	96	117	137			
13	14	35	56	76	97	118	138	159		
14		36	57	77	98	119	139	160		
15		37	57	78	99	119	140	161		
16		37	58	79	99	120	141	161	182	
17		38	58	79	100	120	141	162	182	
18		38	59	79	100	121	141	162	183	
19		38	59	80	100	121	142	162	183	
20		39	59	80	101	121	142	163	183	
21			60	80	101	122	142	163	184	
22			60	80	101	122	142	163	184	205
23			60	81	101	122	143	163	184	205
24				81	101	122	143	164	184	205
25					102	122	143	164	184	205
26					102	122	143	164	184	205
27					102	123	143	164	185	205
28					102	123	143	164	185	205
29					102	123	143	164	185	205
30						123	144	164	185	206

Computed from: $V/B = 1,466.75956/D^2$ for D^2L to 63; $V/B = 41.35529L - 1,141.33695/D^2$ for D^2L larger than 63
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 8.—Gross volumes, in board feet inside bark International 1/4-inch Rule, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 6 inches inside bark. Stump height 1 foot

| d.b.h. | Total height (feet) above ground | | | | | | | | Basis: trees |
	30	40	50	60	70	80	90	100	
inches									
7	9	9	13	20					26
8	9	14	23	32	41				63
9	11	23	34	46	58				58
10	19	33	47	61	76				77
11	27	44	61	78	95	112			55
12	37	57	77	97	117	137			77
13	47	70	94	117	140	164			83
14	58	85	112	139	166	193			68
15	69	100	131	162	193	224			58
16	81	116	151	186	221	256	292		51
17	95	134	173	213	252	291	331		58
18	108	152	196	240	285	329	373		35
19	123	172	221	270	319	368	417		18
20	139	193	247	301	355	409	463		18
21		214	274	333	393	452	511		19
22		237	302	367	432	497	562	627	20
23		260	332	403	474	545	616	687	8
24			362	440	517	594	671	748	4
25			395	478	562	645	729	813	5
26			428	518	609	699	789	880	3
27			463	560	657	754	852	949	2
28				603	708	812	917	1,021	0
29				648	760	872	984	1,096	1
30				694	814	933	1,053	1,173	0
Basis: trees	70	247	276	166	38	9	1	0	807

Block indicates extent of data
Computed from: V = 9 for D^2H to 2,535; V = 0.01286 D^2H – 23.5932 for D^2H larger than 2,535
Standard error of estimate: ±23.36% of mean; ±28 board feet
Coefficient of determination: 0.9408
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 9.—Gross volumes, in board feet inside bark International 1/4-inch Rule per square foot of basal area, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 6 inches inside bark. Stump height 1 foot

d.b.h.	Total height (feet) above ground							
	30	40	50	60	70	80	90	100
inches								
7	29	29	41	65				
8	23	34	58	82	105			
9	23	46	70	94	117			
10	31	55	79	102	126			
11	38	62	85	109	132	156		
12	43	67	90	114	137	161		
13	47	71	94	118	141	165		
14	50	74	97	121	144	168		
15	53	76	100	123	147	171		
16	55	78	102	126	149	173	196	
17	57	80	104	127	151	175	198	
18	58	82	105	129	152	176	200	
19	59	83	107	130	154	177	201	
20	60	84	108	131	155	178	202	
21		85	109	132	156	179	203	
22		86	109	133	157	180	204	227
23		86	110	134	157	181	204	228
24			111	134	158	181	205	229
25			111	135	158	182	206	229
26			112	135	159	182	206	230
27			112	136	159	183	206	230
28				136	160	183	207	230
29				136	160	184	207	231
30				137	160	184	208	231

Computed from: V/B = 1,650.10451/D² for D²H to 2,535; V/B = 2.35782H − 4,325.69396/D² for D²H larger than 2,535
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 10.—Gross volumes, in board feet inside bark International 1/4-inch Rule, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 6 inches inside bark. Stump height 1 foot

d.b.h.	Number of 16-foot logs to 6-inch top										Basis: trees
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	
inches											
7	9	11	18	25							26
8	9	15	24	33	43						63
9	9	20	31	43	54						58
10	11	25	39	53	67						77
11	14	30	47	64	80	97					55
12	17	36	56	76	96	115	135				77
13	20	43	66	89	112	135	158	181			83
14		50	77	103	130	156	183	209			68
15		58	88	118	149	179	209	240			58
16		66	100	134	169	203	238	272	306		51
17		74	113	152	190	229	268	306	345		58
18		83	127	170	213	256	299	343	386		35
19		93	141	189	237	285	333	381	429		18
20		103	156	209	262	315	368	421	474		18
21			172	230	289	347	405	464	522		19
22			189	253	316	380	444	508	572	636	20
23			206	276	346	415	485	555	624	694	8
24				300	376	452	527	603	679	755	4
25					407	489	572	654	736	818	5
26					440	529	618	706	795	883	3
27					474	570	665	761	856	952	2
28					510	612	715	817	920	1,022	0
29					546	656	766	876	986	1,096	1
30						702	819	936	1,054	1,171	0
Basis: trees	44	104	187	212	150	87	18	4	1	0	807

Block indicates extent of data.
Computed from: $V = 9$ for D^2L to 48; $V = 0.25248\ D^2L - 3.05798$ for D^2L larger than 48
Standard error of estimate: ± 21.20% of mean; ± 25 board feet
Coefficient of determination: 0.9512
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Table 11.—Gross volumes, in board feet inside bark International 1/4-inch Rule per square foot of basal area, merchantable stem excluding stump and top, ponderosa pine in the Front Range of Colorado. Top diameter 6 inches inside bark. Stump height 1 foot

d.b.h.	Number of 16-foot logs to 6-inch top									
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
inches										
7	29	36	59	83						
8	23	39	62	85	108					
9	18	40	63	86	110					
10	18	41	64	87	111					
11	19	42	65	88	111	135				
12	20	43	66	89	112	135	158			
13	20	43	66	90	113	136	159	182		
14		44	67	90	113	136	159	182		
15		44	67	90	113	137	160	183		
16		44	67	91	114	137	160	183	206	
17		44	68	91	114	137	160	183	206	
18		45	68	91	114	137	160	184	207	
19		45	68	91	114	137	161	184	207	
20		45	68	91	114	138	161	184	207	
21			68	91	115	138	161	184	207	
22			68	91	115	138	161	184	207	230
23			68	92	115	138	161	184	207	230
24				92	115	138	161	184	207	231
25					115	138	161	184	207	231
26					115	138	161	184	208	231
27					115	138	161	184	208	231
28					115	138	161	184	208	231
29					115	138	161	185	208	231
30						138	161	185	208	231

Computed from: $V/B = 1{,}650.10451/D^2$ for D^2L to 48; $V/B = 46.29093H - 560.66518/D^2$ for D^2L larger than 48
Diameter classes full-inch (e.g., 20-inch class includes 20.0 to 20.9 inches d.b.h.)

Edminster, Carleton B., Robert T. Beeson, and Gary E. Metcalf. 1980. Volume tables and point-sampling factors for ponderosa pine in the Front Range of Colorado. USDA Forest Service Research Paper RM-218, 14 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

Volume tables are presented for total cubic feet, merchantable cubic feet to a 4-inch top, board feet Scribner Rule to a 6-inch top, and board feet International 1/4-inch Rule to a 6-inch top. Point-sampling factor tables are given for merchantable volumes per square foot of basal area. Tree heights are expressed as total height in feet and merchantable height in numbers of logs. Volume equations are the form $V = a + bD^2H$.

Keywords: tree volume tables, point-sampling factors, stand volume estimates, *Pinus ponderosa var. scopulorum*

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Forest Service

Rocky Mountain Forest and Range Experiment Station

The Rocky Mountain Station is one of eight regional experiment stations, plus the Forest Products Laboratory and the Washington Office Staff, that make up the Forest Service research organization.

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Research programs at the Rocky Mountain Station are coordinated with area universities and with other institutions. Many studies are conducted on a cooperative basis to accelerate solutions to problems involving range, water, wildlife and fish habitat, human and community development, timber, recreation, protection, and multiresource evaluation.

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*Station Headquarters: 240 W. Prospect St., Fort Collins, CO 80526